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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/091,983	03/06/2002	Dong Zhong	CS01-067	6380

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EXAMINER	
TOLEDO, FERNANDO L	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 09/28/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/091,983	ZHONG ET AL.	
	Examiner	Art Unit	
	Fernando L. Toledo	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 July 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 June 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1 – 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kraft et al. (U. S. patent 6,136,654) in view of Chou et al. (U. S. patent 6,426,305 B1).

In re claim 1, Kraft, in the U. S. patent 6,136,654; figures 1 – 8 and related text, discloses on a substrate 12, providing a layer of silicon oxide 14; by means of a plasma technique (Column 4, Lines 50 – 55), forming a nitrogen bearing layer 20 that extends downwards a distance from the upper surface; and then annealing the nitrogen bearing layer in a mixture of nitrogen, oxygen at a temperature and a pressure for some time, whereby the nitrogen bearing layer becomes substantially free of structural defects (Column 5, Lines 9 – 17).

Kraft does not disclose wherein the plasma technique is a decoupled plasma technique nor that the temperature is between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes.

Chou, in the U. S. patent 6,426,305 B1; figures 1 – 3D and related text, discloses, wherein decoupled plasma nitridation (DPN) is a low-temperature process that will not adversely affect photoresists used during the nitridation process (Column 3, Lines 40 – 45).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form a nitrogen bearing layer in the invention of Kraft, by DPN, since as taught by Chou, DPN is a low-temperature process that will not adversely affect photoresists used during the nitridation process.

Kraft in view of Chou does not disclose that the temperature is between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to anneal the nitride bearing layer of Kraft in view of Chou at a temperature of between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233. Note that the specification contains no disclosure of either the critical nature of the claimed temperature ranges, pressure ranges and time ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen temperature ranges, pressure ranges and time ranges or upon another variable recited in a claim, the Applicant must show that the chosen temperature ranges, pressure ranges and time ranges are critical. *In re Woodruf,* 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, the selection of temperature, pressure and time, its obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685,

1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and In re Aller, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

3. In re claim 2, Kraft in view of Chou discloses wherein the step of decouples plasma nitridation further includes using RF power between 250 and 350 Watts at a pressure of $1\text{-}3x10^{-2}$ torr for 10 – 300 seconds (Column 6, Lines 31 – 39 of Chou).

4. In re claim 3, Kraft discloses wherein the nitrogen bearing layer is selected from the group consisting of silicon nitride or silicon oxynitride (Column 4, Lines 12 – 29).

5. In re claim 4, Kraft discloses wherein the nitrogen bearing layer contains at least 3 atomic percent nitrogen (Figure 7).

6. In re claim 5, Kraft discloses wherein the mixture of nitrogen and oxygen contains between about 10 to 30 volume percent oxygen (Column 4, Lines 12 – 29).

7. In re claim 6, Kraft discloses wherein the distance that the nitrogen bearing layer extends downward from the upper surface is between 2 and 10 Å (Figure 7).

8. In re claim 7, Kraft discloses wherein the layer of silicon oxide has a thickness between about 8 and 30 Å (Column 4, Lines 45 – 47).

9. Claims 8 – 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bertrand et al. (U. S. patent 6,632,740 B1) in view of Kraft and in view of Chou.

In re claim 8, Bertrand discloses, in the U. S. patent 6,632,740 B1; figures 1(A) – 2(E) and related text, providing a silicon wafer 1, of a first conductivity type, and forming thereon a layer of silicon oxide 4 having an upper surface; depositing a layer of polysilicon 6 on the layer of silicon oxide; patterning and etching the layer of polysilicon and the layer of silicon oxide to form a gate pedestal on a layer of gate oxide (Figure 9); and using the gate pedestal as a mask, forming source and drain (8 and 9) regions of a second conductivity type that immediately abut the gate oxide, thereby forming the field effect transistor and whereby the field effect transistor has an electrical performance as good as a device that is similar in all respects to the field effect transistor except for the absence of the nitrogen bearing layer (Figure 2C).

Bertrand does not disclose, by means of decoupled plasma nitridation, forming a nitrogen bearing layer that extends downwards a distance from the upper surface; then annealing the nitrogen bearing layer in a mixture of nitrogen and oxygen, at a temperature between about 1000 and 1100 ^{0}C and a pressure between 5 and 15 torr, for between about 60 and 150 minutes, whereby the nitrogen bearing layer becomes substantially free of defects.

However, Kraft discloses, by means of a plasma nitridation technique (Column 4, Lines 50 – 55), forming a nitrogen bearing layer 20 that extends downwards a distance from the upper surface; and then annealing the nitrogen bearing layer in a mixture of nitrogen, oxygen at a temperature and a pressure for some time, whereby the nitrogen bearing layer becomes substantially free of structural defects (Column 5, Lines 9 – 17), since according to Kraft the scaling of the devices in the lateral dimension requires vertical scaling as well so as to achieve adequate device performance. This vertical scaling requires the thickness of the gate dielectric to be reduced so as to provide the required device performance (Column 1, Lines 26 – 31).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to by means of decoupled plasma nitridation, forming a nitrogen bearing layer that extends downwards a distance from the upper surface; and then annealing the nitrogen bearing layer in a mixture of nitrogen, oxygen at a temperature and a pressure for some time, whereby the nitrogen bearing layer becomes substantially free of structural defects in the invention of Bertrand, since, as taught by Kraft, the scaling of the devices in the lateral dimension requires vertical scaling as well so as to achieve adequate device performance. This vertical scaling requires the thickness of the gate dielectric to be reduced so as to provide the required device performance.

Bertrand in view of Kraft does not disclose wherein the plasma technique is a decoupled plasma technique nor that the temperature is between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes.

Chou discloses wherein decoupled plasma nitridation (DPN) is a low-temperature process that will not adversely affect photoresists used during the nitridation process (Column 3, Lines 40 – 45).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form a nitrogen bearing layer in the invention of Bertrand in view of Kraft, by DPN, since as taught by Chou, DPN is a low-temperature process that will not adversely affect photoresists used during the nitridation process.

Bertrand in view of Kraft and in view of Chou does not disclose that the temperature is between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to anneal the nitride bearing layer of Bertrand in view of Kraft at a temperature of between about 1,000 – 1,100^{0}C and a pressure between 5 – 15 torr and for about 60 – 150 minutes, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233. Note that the specification contains no disclosure of either the critical nature of the claimed temperature ranges, pressure ranges and time ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen temperature ranges, pressure ranges and time ranges or upon another variable recited in a claim, the Applicant must show that the chosen temperature ranges, pressure ranges and time ranges are critical. *In re Woodruf,* 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, the selection of temperature, pressure and time, its obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and In re Aller, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

10. In re claim 9, Bertrand in view of Kraft and Chou does not disclose wherein the gate pedestal has a width between about 0.05 to 0.25 microns.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made have a gate pedestal with a width of between 0.05 to 0.25 microns in the invention of Bertrand in view of Kraft and Chou, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233. Note that the specification contains no disclosure of either the critical nature of the claimed width or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen width or upon another variable recited in a claim, the Applicant must show that the chosen width is critical. *In re Woodruf,* 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, the selection of width ranges, its obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and In re Aller, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

11. In re claim 10, Bertrand in view of Kraft and in view of Chou discloses wherein the step of decouples plasma nitridation further includes using RF between 250 and 350 Watts power at a pressure of $1\text{-}3x10^{-2}$ torr for 10 – 300 seconds (Column 6, Lines 31 – 39 of Chou).

12. In re claim 11, Bertrand in view of Kraft discloses wherein the nitrogen bearing layer is selected from the group consisting of silicon nitride or silicon oxynitride (Column 4, Lines 12 – 29 of Kraft).

13. In re claim 12, Bertrand in view of Kraft discloses wherein the nitrogen bearing layer contains at least 3 atomic percent nitrogen (Figure 7 of Kraft).

14. In re claim 13, Bertrand in view of Kraft discloses wherein the mixture of nitrogen and oxygen contains between about 10 to 30 volume percent oxygen (Column 4, Lines 12 – 29 of Kraft).

15. In re claim 14, Bertrand in view of Kraft discloses wherein the distance that the nitrogen bearing layer extends downward from the upper surface is between 2 and 10 Å (Figure 7 of Kraft).

16. In re claim 15, Bertrand in view of Kraft discloses wherein the layer of silicon oxide has a thickness between about 8 and 30 Å (Column 4, Lines 45 – 47 of Kraft).

Response to Arguments

17. Applicant's arguments filed 19 July 2004 have been fully considered but they are not persuasive for the following reasons.

18. Applicant argues the following:

> With the greatest respect, we must point out hat what we actually wrote was "This argument by Examiner would be valid if Kraft's process included an annealing step. But it does

> not! See for example Kraft's FIGs. 4a and 4b." This difference between our statement and Examiner's summary thereof is important because, in col. 5 line 11 Kraft merely notes that "...a post nitridation anneal can be altered/used...", but nowhere does Kraft teach that it is required if his invention is to work properly. We refer again to his FIGs. 4a and 4b which summarize his invention. Thus, having demonstrated that he is aware of the possibility of a post nitridation anneal, Kraft does not include it in his process (where it would be counter-productive).

Examiner respectfully submits that Kraft does teach a post anneal step that would work with the patented invention, since, Kraft discloses in Column 5 that in step 504 a post-anneal can be use "to either drive the nitrogen further into or not drive as far into the insulating layer or the underlying semiconductor structure and repair any dielectric and/or substrate damage." Kraft does not show anywhere that the post nitridation anneal would be counter-productive, in fact, Kraft seems to teach advantages to a post-anneal treatment in the patented invention.

19. Applicant also argues the following:

> Additionally, there remains the question of how, precisely, a post nitridation anneal is to be implemented. The present invention claims a post nitridation anneal that is to be carried out in a mixture of nitrogen and oxygen. Examiner asserts that this, too, is taught by Kraft, citing col. 4 lines 12-29. We must respectfully point out that this is incorrect, said teaching relating, in fact, to the composition of the **plasma** that is used in step 504. In a post nitridation anneal there is no plasma present, only unionized gas and, furthermore, exposure to a plasma would be likely to increase the density of structural defects, not decrease it, as we claim.

Examiner respectfully submits that the post anneal step is carried out at step 504 as stated on column 5, line 9. The atmosphere in the chamber during step 504 is described in detail on the cited column and lines in the rejection. Kraft merely does the post anneal step in the same atmosphere after the plasma step has finished. Therefore, the U.S.C. §103 rejection, above stand and is considered proper.

Conclusion

20. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando L. Toledo whose telephone number is 571-272-1867. The examiner can normally be reached on Mon-Thu 7am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

George Fourson
Primary Examiner
Art Unit 2823

FToledo
27 September 2004